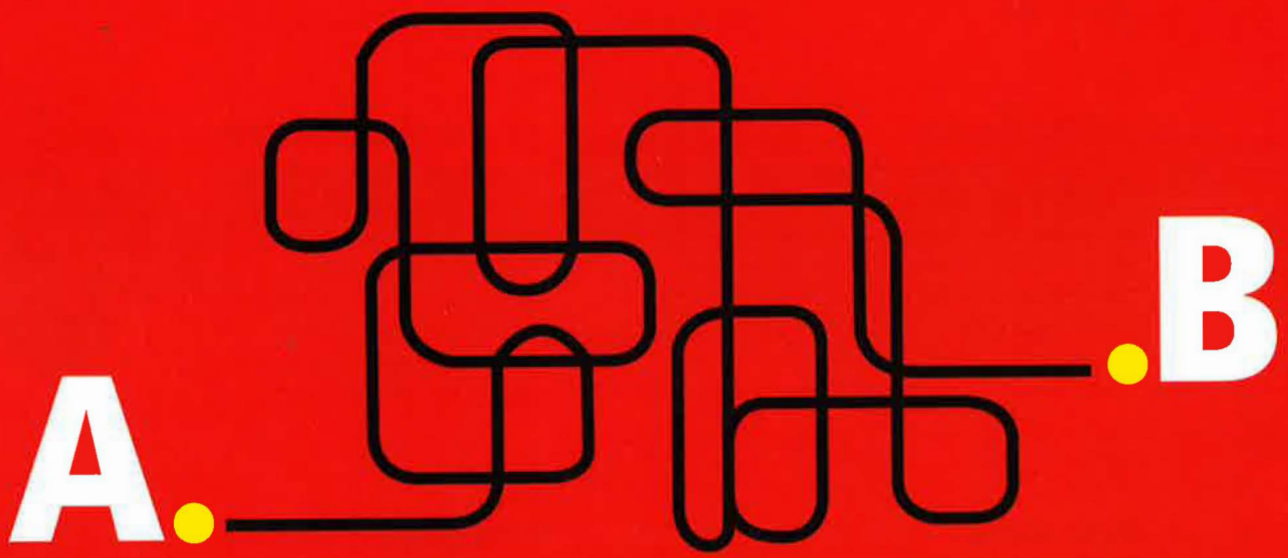
Cold coral Bear bones Power of compassion

1865 THE UNIVERSITY OF MAINE

UMaine Today

CREATIVITY AND ACHIEVEMENT AT THE UNIVERSITY OF MAINE

WINTER 2012



Space travel

How can virtual reality inform our navigation of real-world environments?

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ON THE COVER: Getting from Point A to Point B requires object detection, spatial scene reconstruction and other cues that are not readily available to persons with visual impairments, including the elderly. Developing technologies to aid in navigating indoor and outdoor environments is a focus of the Virtual Environment and Multimodal Interaction Lab at UMaine. See story on page 2.

1865 THE UNIVERSITY OF MAINE

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Spatial informatics research taps into human perception and cognition to create intuitive technologies

Sight unseen

By Jessica Bloch

NICHOLAS GIUDICE started at the University of Maine in 2008 with a plan to create UMaine's first virtual reality research facility in his empty Boardman Hall lab. Today that lab has a name — the Virtual Environment and Multimodal Interaction (VEMI) Laboratory. But by most standards, it is still relatively empty, except for storage cabinets, neon-colored tape on the carpeted floor, computers and some specialized equipment that allows the user to walk around the space while immersed in computer-simulated worlds called virtual reality.

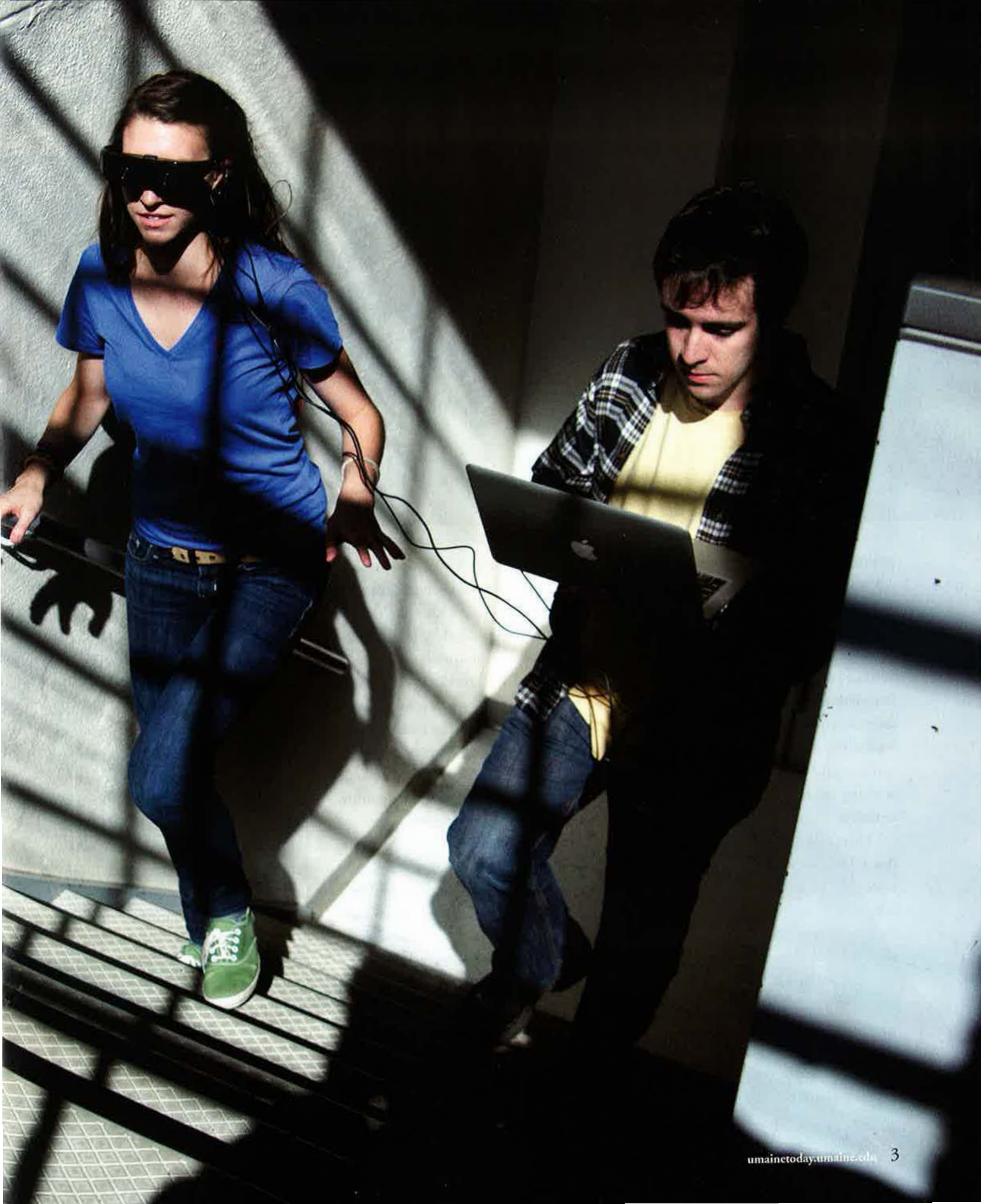
What fills the room is the hum and spirit of the nearly two dozen students, faculty and staff who help transform Giudice's research in spatial informatics and cognitive neuroscience into what could soon be everyday applications for navigating indoor and outdoor environments using technology accessible to people both with and without sight.

To support their research, Giudice and his students have developed the state's first fully immersive virtual reality installation. The system utilizes a head-mounted display with a wide field of view and a high-resolution stereo display that allows users to see and hear a computer-generated 3D environment as if they were actually in the physical space.

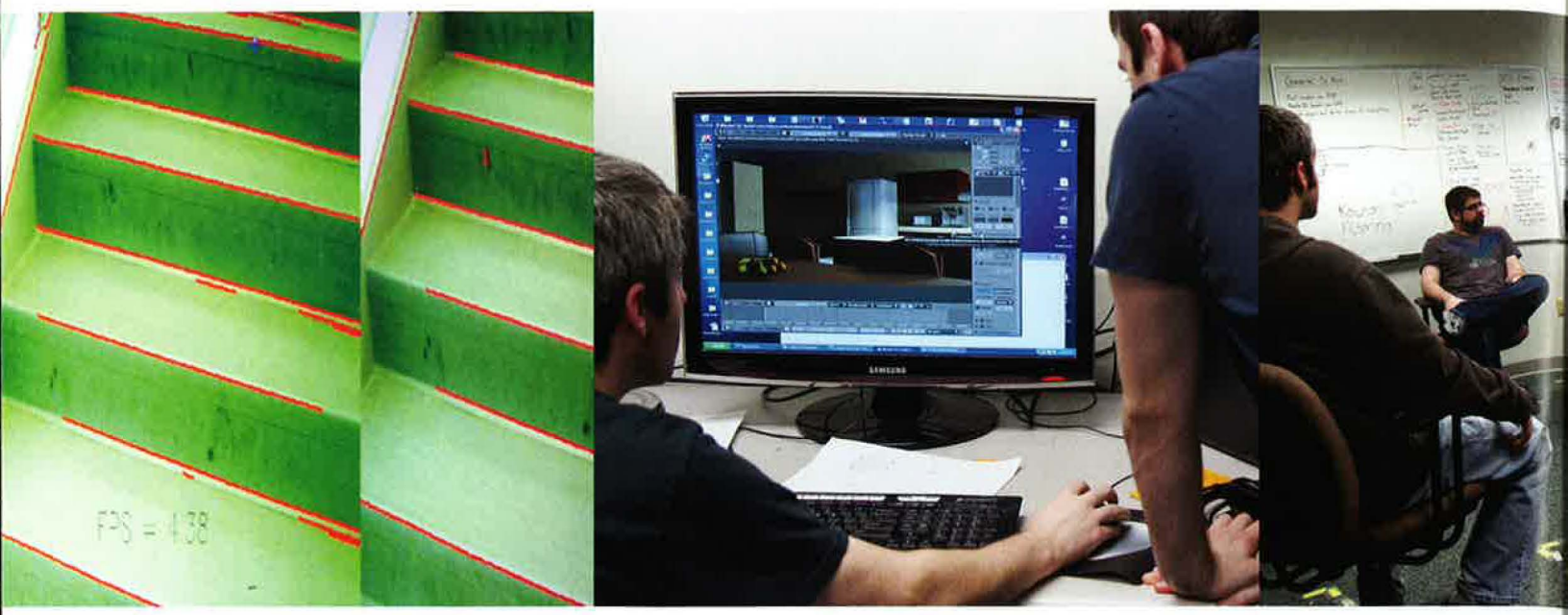
Unlike the real world, anything can be changed in virtual reality, Giudice says. If you want a building's walls to turn blue or become transparent, or to see how it would look in downtown Orono, it is easy in VR.

In the four years since he joined the UMaine faculty, Giudice's research has led to more than 60 combined journal publications and conference

Computer engineering major Michelle Beauchemin and Jonathan Cole, a computer science major, test an augmented reality detection system developed by recent UMaine graduate Joshua Leger.



Sight unseen



presentations, and he has been a part of 13 awarded grants, proposals and contracts totaling around $2 million from a variety of sources, notably the National Institutes of Health and the National Science Foundation (NSF). The funding has allowed Giudice to acquire crucial software and hardware, and is currently supporting five graduate student research projects and a crew of undergraduates working on research and development initiatives.

These research efforts are guided by two UMaine Ph.D. students: VEMI Lab manager Rick Corey, who worked alongside Giudice to start the lab and who leads the R&D team, and lab research coordinator Bill Whalen.

"I feel very strongly about doing theoretically driven research, but also having a translational component to my work based on knowledge of human perception and cognition to create intuitive and usable technologies," says Giudice, an assistant professor in UMaine's School of Computing and Information Science. "A lot of times products get stuck in the engineering trap, motivated by good intentions and intuition, but with the solutions neither based on how humans actually learn and process information nor addressing real challenges of the intended end user. My research allows me to play on both sides of the fence, combining basic science about human spatial cognition with human factors engineering."

For Giudice, applied research has an urgency, and not only because of his own experience with visual impairment. In a state such as Maine, with the oldest median population in the country, improved adaptive technology could be crucial in helping people maintain their independence and quality of life. The technology currently being studied in the lab would be incredibly helpful as a way to simply navigate a complex interior space, similar to GPS systems in cars.

"There is all kinds of research on visual or hearing aids for elders," says Giudice, "but hardly any work studying how technology could aid navigation, which is one of the most important things we do in our daily life, but also one of the biggest challenges for older folks."

GIUDICE'S OWN EXPERIENCES navigating his way through the ins and outs of daily life without vision have provided phenomenological insight in his research.

"Having firsthand experience of navigating without vision definitely initially helps me to isolate research questions and design technology, which I then refine by doing behavioral research or conducting focus groups about the actual issues that are challenging," he says. "The bottom line is that spatial behaviors are critical to our lives and if people cannot safely and efficiently navigate their environment, their vocational, social and educational opportunities become really contracted."

At the heart of Giudice's research is his interest in multimodal spatial cognition — how we learn about, think about and act in space using different senses. For most of us, vision is the primary sense we use to move in space. But what characteristics of an object can be specified through other senses, such as touch and hearing? And how do those senses play a role in the way we accurately move in space when we deal with a visual impairment, such as blindness or simply a dark room?

"All of our senses convey spatial information; my interest is in understanding how we process and act in space using these different inputs and studying how much of what we do is really guided by visual versus spatial cues," says Giudice.

Giudice's research on multimodal spatial cognition has consistently found that many spatial tasks done with vision can be undertaken equally well using other senses. His findings are rooted in the functional equivalence hypothesis that contends that spatial information from different senses is represented in the brain in a purely spatial representation that is not related to the input.

"Since we know that learning with different senses can lead to common representations in the brain that equally support spatial behaviors, it opens the door for all kinds of sensors and non-visual interfaces, such as audio or vibrotactile interfaces to do the same thing via information which is traditionally given solely through visual displays."

GIUDICE IS WORKING on the challenge of indoor navigation on several fronts. Ph.D. student Hengshan Li is studying new visualization techniques for use on portable displays, allowing users to see through walls and floors to improve navigation in large buildings. Two other students, Monoj Raja, who earned his master's degree this year with Giudice as chair, and Hari Palani have been exploring the sense of touch in combination with vibration — known as vibrotactile input, for learning maps of buildings without vision using tablets and smartphones. Their work explored the use of software that could take a map of a floor, feed it to the touch screen of a phone, and convert the map to stripped-down images where hallways and room outlines are represented using vibrotactile lines, which users feel by tracing the line with their fingertip. Recent work has also shown the efficacy of this interface for learning bar graphs, figures, and other graphic material traditionally completely inaccessible without vision.

"There's a huge amount of possibility for this interface given that it can also be augmented with audio, vision or language, and is implemented on a low-cost, multi-use platform; it has enormous potential for education and workplace applications," Giudice says.

"With respect to indoor navigation and spatial learning, the advantage here is that a person can learn about a space ahead of time and build up a cognitive map, and then once we get better positioning we could use it in real time as well — maybe as you walk down a hall there's

Top photos, left to right: A recent undergraduate student project used augmented reality to superimpose high-contrast lines on the edge of stairs to reduce falling — one of the biggest safety risks for elders. Virtual reality is a key to the VEMI Lab's research on indoor navigation systems. The lab's weekly development meetings, at which students present updates on their research projects, are filled with almost as much creative banter as business. Photo lower right: a virtual simulation of driving with impaired vision on city streets.

Sight unseen

Professor Nick Giudice adjusts the head-mounted display of Timothy McGrath, a senior mechanical engineering major who has worked in the VEMI lab for three years.

a vibrating dot that tells you where you are and you can feel what you're going by. Just another example of how to provide a useful interface that is nonvisual and able to be done with off-the-shelf hardware."

The off-the-shelf aspect is crucial because the costs of adaptive technology are often prohibitive, frequently many thousands of dollars. The main thrust of Giudice's research involves studying how solutions can be built on existing hardware, such as smartphones, and be used for multiple purposes.

THE PIECES OF tape on the floor of the VEMI Lab belong to another graduate student, Chris Bennett, who is researching the basic psychology of how touch and other sensory modalities change with age.

"If we want to start tailoring devices to elders, we need a better understanding of basic science questions of how perceptual and cognitive factors relating to spatial behaviors change over the life span," says Giudice. "Chris is working on ways to get at the spatial differences that exist between younger and older people."

Another example of developing technology based on knowledge of the cognitive aspects of the human end user is evident in a four-year, $700,000 NSF-funded research project on which Giudice is a co-principal investigator, along with UMaine School of Computing and Information Science faculty members Kate Beard and Reinhard Moratz. The research seeks to develop computational methods for object detection, spatial scene reconstruction, and natural language spatial descriptions of prototypical indoor spaces, such as lobbies and offices — a project the researchers hope will eventually result in a device that could help blind and visually impaired people lead more independent lives.

Giudice and graduate student Saranya Kesavan are studying the language people use to describe spaces and then to determine automated techniques to generate verbal descriptions from an image that support accurate learning and navigation of these indoor environments.

"There is a lot of focus on how to get from A to B, but no system to actually describe the destination once you arrive," Giudice says. "It can often be just as hard to find the check-in desk in the hotel lobby as it is to find the hotel. This project will help in solving this challenge."

Companies also hire Giudice and his students to model events, simulate environments and present complex data sets. The lab has produced projects such as a 3D multimodal simulation of a wind farm installation and a 3D simulation for emergency response training scenarios.

In early 2012, an Australian company, Majella Global Technologies, asked the lab to generate a 3D representation of the kitchen, dining space and living area of an apartment it was constructing in order to have a realistic model to show potential customers. A group of undergraduates in the lab, with guidance from Corey, designed the computer representation, perfecting the details down to the size of the fruit in a bowl on a dining room table. The company liked what it saw, and gave the lab $80,000 to start another project.

The funds help the lab purchase new software and hardware, and pay five undergraduate student salaries for further R&D research. ■

Forward thinking

UMaine alum embraces the challenge of being first

RICK COREY HAS been something of a groundbreaker at the University of Maine. As an undergraduate in the early 1990s, he was part of the first group to participate in Semester by the Sea, UMaine's popular marine sciences program at the Darling Marine Center. He was among the first students to work at ASAP Media Services, a UMaine new media and Internet technologies lab.

Years later, after a career in marketing and advertising, he returned to UMaine as a member of the first class in the Master of Fine Arts Intermedia Program. Around the time he started in the MFA program, Corey was the first employee in UMaine's Virtual Environment and Multimodal Interaction (VEMI) Lab, founded in 2008 by assistant professor Nicholas Giudice of the School of Computing and Information Science.

Now, Corey is helping UMaine undergraduates attain firsts of their own as they learn new computer programs and concepts in the VEMI Lab, where Giudice researches spatial informatics and cognitive neuroscience that could one day lead to applications for navigating environments using technology accessible to people with and without sight.

Among Corey's responsibilities as the leader of the lab's R&D team is to provide guidance for a group of undergraduate workers and researchers who help complete projects for companies that hire the lab. Those projects include modeling events, simulating environments and presenting complex data sets.

In addition to working on contracted projects, the undergraduates also develop technologies for graduate students doing research with Giudice. Corey, the VEMI lab manager, and Bill Whalen, the lab's research coordinator, meet weekly with the undergraduates in a session that can at times feel like it's taking place in a clubhouse rather than a high-level research facility. A conversation on the status of a project might turn into a debate about which UMaine dining facility serves the best french fries.

That kind of atmosphere is by design, Corey says. Recalling his own undergraduate days working at ASAP, he was given a lot of opportunities from new media faculty member Mike Scott, the director of ASAP R&D, who constantly challenged the student employees. Facilitating those opportunities and challenges is a similar approach Corey brings to the VEMI students.

"I want this place to not only be fun, but also a challenge, and I want people that want to learn and want to do new things," Corey says. "I think there is legitimate excitement to be here because it is a challenge. Everything is new and different, and can lead to more projects. It can be very serious stuff, and there are times I have literally had to tell people to go home, get some rest, come back the next day, which is why we try to have some fun, too. It's a certain rhythm."

Corey can seem stern as he quizzes group members about their progress toward R&D deadlines, but he also will immediately offer assistance to find a creative way to fix a bug in the computer program or praise the undergraduates for mastering a tricky design challenge.

In return, the undergraduates' eagerness shines through. During one recent meeting, as Corey explained a project coming their way, the students sat on the edges of their seats.

"What we're doing now is basically having them push the technology to learn more," Corey says. "I know of projects, such as grants or contracts, that if we get them, we need to do X, Y and Z to get an understanding of these things. We're always trying to do a lot of forward thinking." ■

Alumnus Rick Corey, far right, with then undergraduate researcher Joshua Leger. Leger received his computer engineering degree in May from UMaine.

Power of compass

Social psychological research focuses on the understanding and caring deemed critical to social growth and well-being

By Scott Peterson

THE CALL FOR compassion lies at the heart of every major world religion. Yet, at the same time, religious practices can lead to intergroup bias that creates the opposite effect.

Social psychologist Jordan LaBouff has observed this paradox firsthand.

"I first became interested in compassion, empathy and religion by watching my grandmother," he says. "For the last decade or so, she has been increasingly involved with the people at a nearby drug rehab facility — bringing them to church and offering them their own Sunday school class, visiting them and so on. My grandmother's empathy — her ability to genuinely feel what another person might be feeling — helped me understand that religion can help to build some incredible intergroup bridges.

"At nearly the same time, my pastor father was being chastised in a growing suburban church for allowing African-Americans to come to a church youth group event."

Religion's ability to bring people together and divide them has served as a motivation for LaBouff's wide-ranging research. In one line of inquiry, he has observed how humility is linked to being helpful to others. In another line, he's seen that the proximity of a church or the experience of an imagined conversation can activate a person's conservative opinions or change their attitudes. In yet another line, his work examines how attitudes toward minority groups influence support for social programs and policies.

At first glance, LaBouff's research would seem to go in three

ion

very different directions. But in all, the common thread is compassion.

"Empathy and compassion are the building blocks of human community. When understanding and caring for others is central to a society, we see the greatest social growth and well-being. In societies where these critical qualities are ignored, we sometimes see the worst acts of human history," says LaBouff, who joined the University of Maine faculty last year as an Honors Preceptor in Psychology — one of four preceptors named in the College of Liberal Arts and Sciences.

LABOUFF GREW UP in Tulsa, Okla., and went to Baylor University on a debate scholarship to study English and history with the intention of becoming a constitutional lawyer. Involvement with the honors program and one Introduction to Psychology class were enough to convince him to participate in the humility studies of his mentor, experimental psychologist Wade Rowatt.

In his research on humility — not to be confused with the biblical meek — during his decade at Baylor, LaBouff found that humble people possess an accurate self-perception, less focus on themselves and a propensity for helpfulness. A key element of his humility research is the link between the willingness to help others and the compassion found in sacrifice and generosity.

Beyond being the only personality trait that predicts for helping, LaBouff also learned that humility had implications for advancement.

"We found that humble people are often good leaders," says LaBouff, whose research findings on humility were published in the *Journal of Positive Psychology* and generated significant media interest. "The problem is that those people are rarely found in leadership positions, although they tend to do well once they get into that role."

LaBouff also turned to the psychology of religion to study intergroup bias and mechanisms for reducing it. He studied the influence of religious and nonreligious settings on people's attitudes toward other groups and found that, once thoughts of religion are activated by the presence of a house of worship, people tend to be more conservative when interviewed about social issues like gay marriage, capital punishment, immigration and support of warfare.

"We found that by activating religious thoughts through subliminal or conscious priming, we could change intergroup attitudes to be more prejudicial and evoke politically conservative attitudes, even in nonreligious people," says LaBouff, who coauthored a paper on his findings in the *International Journal for the Psychology of Religion.*

That activation of religiousness might very well have larger implications when people are voting on socially charged ballot issues in houses of worship, as is the case in some southern states — and some polling sites in Maine.

INTERGROUP BIAS against Muslims has been an interest of LaBouff's since the 9/11 attacks that occurred early in his college career. His initial findings in that area contained yet another paradox: People with the most bias often had the least ability to reduce that bias.

LaBouff was able to explore that paradox further when he supervised the honors thesis of Charles Bergeron, who recently graduated from UMaine with degrees in psychology and political science. Bergeron's thesis investigated the effects of positive interaction on prejudice by asking subjects to imagine a conversation with a Muslim person.

"Some of the responses were amazingly detailed. We asked people to describe their imagined interactions and the subjects in that group described universally positive interaction with a fellow human being. They frequently learned they had something in common with them. In the other condition, most of the responses were filled with prejudicial ideas. So it was interesting to see the

change in their way of thinking about people after something as small as a three-minute exercise," says LaBouff, who will join Bergeron in presenting the data from the honors thesis at the international conference of the Society for Personality and Social Psychology in January.

THE MECHANISMS at work in people's reactions to affirmative action, welfare and Obamacare make up LaBouff's third line of research. After seven studies, he and his colleague observed that racial attitudes tended to explain reactions to Obamacare and similar programs. As with the Muslim bias, LaBouff found that education could be used to reduce the bias.

"We were interested in the barriers and why they opposed the programs," he says. "Over time, we got interested in how we could fix the opposition. After the original research, we ultimately found that the more people are presented with education about the groups that needed help, the more their prejudices are reduced and the more they are interested in helping those groups."

LaBouff has found that the source of bias, whether driven by an inflated self-image, religion or racial attitudes, can be addressed and remedied through education, positive experience and other elements of the compassion sought by the world's religions.

"We are starting to understand the functional role that religion plays in larger issues, so that we can apply that knowledge to policy decisions on a number of levels," LaBouff says. "Ultimately, all the lines of research are pointed at investigating and understanding about how religion plays into these intergroup relationships. These relations drive our political decisions and influence our social behavior, including whom we spend time with, where we choose to live, the causes we choose to support."

AT UMAINE, LaBouff has expanded his research focus and involved dozens of undergraduates in his work. He plans to continue to investigate how both real environments and imagined interactions influence attitudes and actions, and how religion is related. And now that he has developed a definition of and a method for measuring humility, LaBouff intends to address the relative scarcity of that personality trait by studying how to actively cultivate and practice it.

"Empathy and compassion are the building blocks of human community. When understanding and caring for others is central to a society, we see the greatest social growth and well-being. In societies where these critical qualities are ignored, we sometimes see the worst acts of human history."

Jordan LaBouff

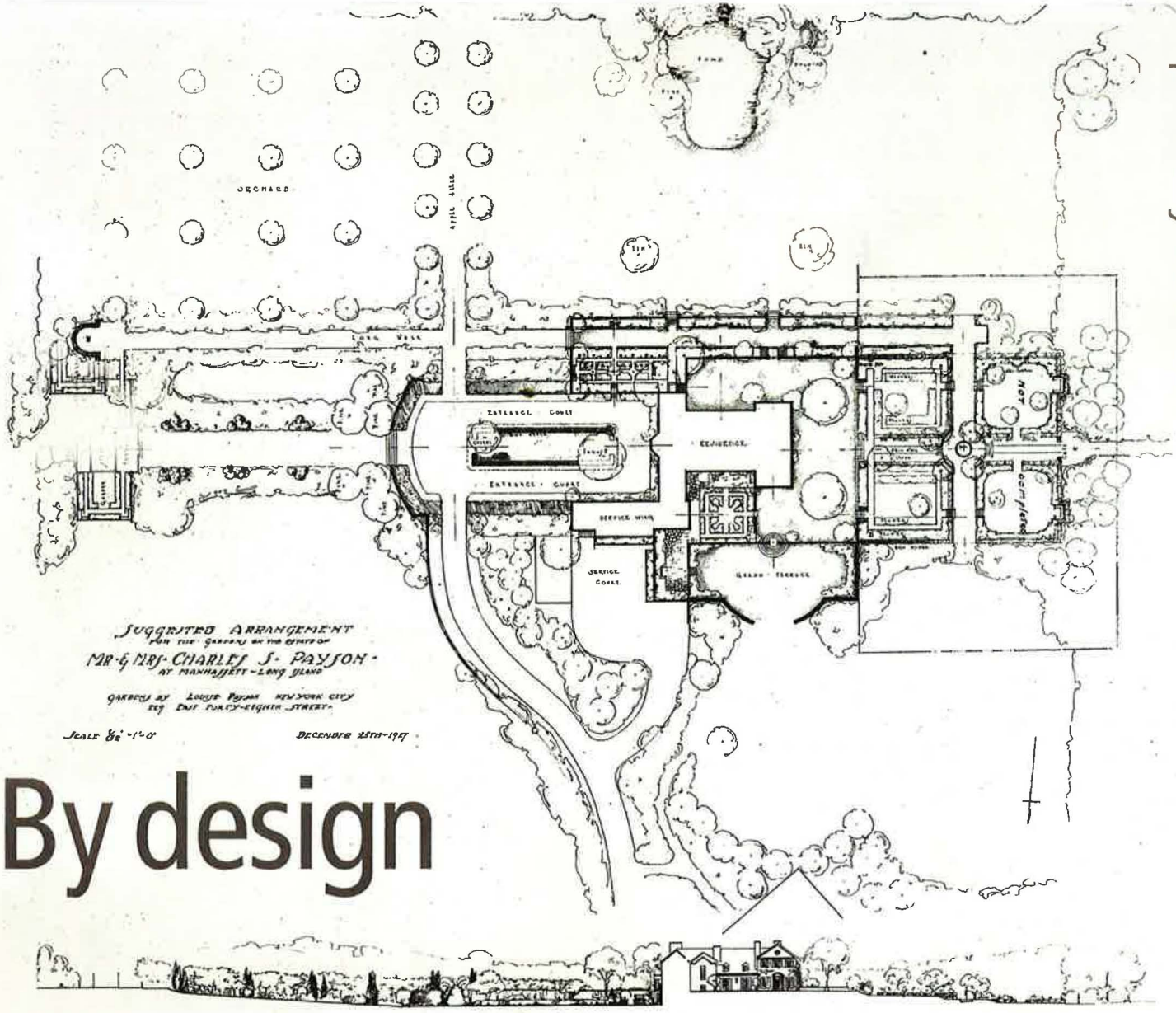
To continue his religion research, LaBouff is conducting a follow-up study in three houses of worship in Bangor, Maine, to see how they activate the religiousness of Mainers. In addition, he and Bergeron are planning to add a physiological component to their Muslim bias studies.

LaBouff also is collaborating with Rob Glover, the Honors Preceptor who joined the Political Science Department faculty last year, to examine the political, racial and religious implications of public reactions to the DREAM Act and Arizona's Proposition 200.

"Religion has played a central role in these intergroup relations across time. Each of these studies is designed to help us figure out how to humanize other groups, remove barriers, and increase empathy and understanding to create positive interaction," LaBouff says. "The more we can humanize those groups, the more we can understand them, the less likely we are to hate them."

Empathy and compassion — really understanding how another person feels in a situation, from their motives to their emotions — are remarkably powerful forces, LaBouff says. They have the potential to diffuse conflicts and prejudice, increase altruism and build community.

"They're challenging," he says, "but I'm hopeful that our research and the research of others will help us to understand these qualities and how their expression (or lack thereof) helps to shape our world." ■



By design

ELLEN LOUISE PAYSON was a pioneer of American landscape architecture who helped define the aesthetics of garden and estate design in the United States in the first half of the 20th century. Born in Portland, Maine, in 1894, Payson graduated from Lowthorpe School of Landscape Architecture for Women in Groton, Mass., and attended Columbia University's School of Architecture. She established an office in New York City in 1927 and gained national recognition for her designs for private estates in Connecticut, New Jersey, Pennsylvania and New York.

In 1933, she and five other women were named to *House & Garden* magazine's Hall of Fame. Payson was cited for "the soundness with which she applies to her gardens the principles of landscaping and architecture" and the "sympathetic feeling for varying material which her work always shows."

For decades, the whereabouts of much of Payson's original plans, drawings and other works were unknown. It wasn't until shortly after her death in 1977 that family members discovered a sizable collection of her original materials.

In 1999, the University of Maine received a donation of more than 500 of Payson's original landscape architecture plans, contour drawings, planting diagrams and blueprints. The drawings spanning 1913–40 reflect Payson's work in Maine, New York, New Jersey, Missouri, Connecticut and North Carolina, and demonstrate the process of landscape design — from rough sketches and sketches on older blueprints to preliminary and alternative drawings, and final plans and blueprints.

The collection is a resource for horticulture students and professionals, many of whom use the collection to research how to return heritage landscapes to their original designs. ■

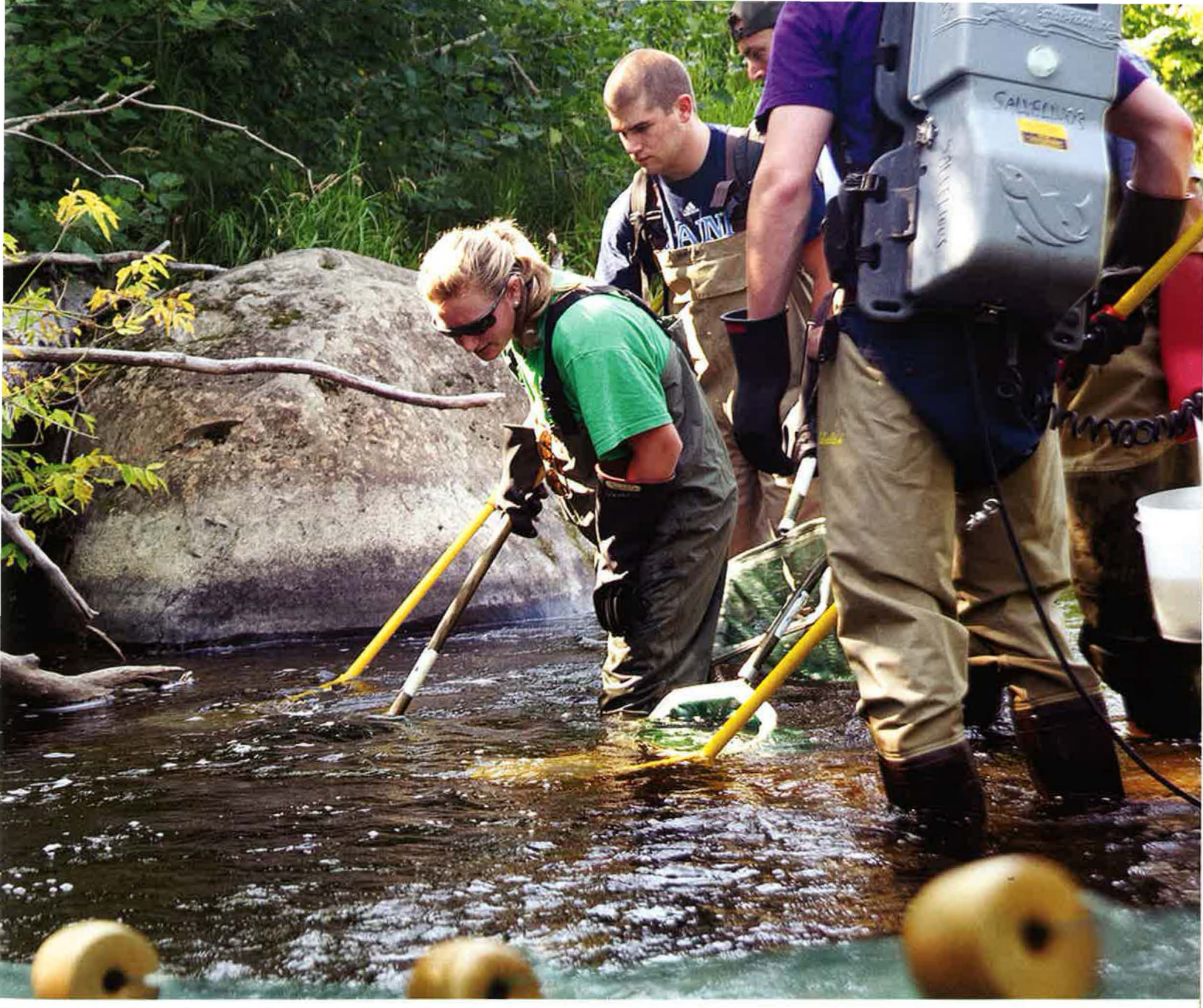
River reviver

UMaine researchers study the role of lamprey in stream restoration

By Jeff Tuttle

UMaine students electrofishing in the Sedgeunkedu

THE THRASHING black and amber fish in Stephen Coghlan's grip is unsightly, but its humble appearance — a snake-like body, milky eyes and parasitic funnel of yellow teeth — belie the sea lamprey's importance to the small Sedgeunkedunk Stream and, possibly, Coghlan contends, some of the state's most majestic rivers.



tream on the hunt for sea lamprey to better understand the importance of the anadromous fish in the ecosystem.

Coghlan, an associate professor of freshwater fisheries ecology at the University of Maine, has spent many hours ankle-deep in the Sedgeunkedunk (pronounced Sej-E-unk-e-dunk) studying the lamprey's impact on the stream since the removal of two dams about three years ago allowed the fish to return to their traditional spawning grounds. In that time he has seen steady increases in the number of lamprey building nests on the stream bottom and, in the process, changing the environment, possibly making it more hospitable to highly prized sea-run fish, including Atlantic salmon.

"We're trying to tell a story, and each year we get a little bit more information," Coghlan says, carefully placing the now-weary lamprey into a submerged basket and jotting down the measurements of others caught and tagged that morning by his student researchers.

The story is set in the living laboratory of the Sedgeunkedunk Stream, a small tributary running north about 3.7 miles from Orrington, Maine, and into the Penobscot River in South Brewer.

On this sunny morning, Coghlan and his team of undergraduate and graduate students are on their daily "lamprey safari," walking the stream and carefully hand-catching and tagging any lamprey they see. Each captured fish receives both

a visible tag and an electronic tag that can be scanned for identification.

Part of the reason the lamprey are so easy to catch is that they're very busy building their nests. And there's some heavy lifting involved, too, as they use their sucker-like mouths and thrashing bodies to move rocks — some as big as grapefruits — into a mound where they will lay their eggs. An oval pit, worn clean and smooth by the lamprey's slow, constant wriggling, is at the base of the mound.

Once sea lamprey spawn, they die. That's it. But they leave behind three important things: their bottom-changing nests, their nutrient-rich carcasses and the next generation of lamprey.

Since the removal of the dams in 2008 and 2009, Coghlan and his team have documented increasing numbers of sea lamprey returning to the Sedgeunkedunk to build or enlarge their nests, which, in some cases, can be several feet across. Five years ago, there were about 60 fish. This year, he and his team tagged a record 250, and the fish are moving farther and farther upstream to spawn, expanding their range.

SEA LAMPREY, which is parasitic at one stage of its life, has a reputation for decimating lake trout populations in the upper Great Lakes, where it is invasive. However, populations in Lake Ontario and the Finger Lakes are probably native, but still viewed as a scourge on sport fish and deserving of eradication. But that's not the case in Maine, Coghlan says, where the lamprey are native and had coexisted with other sea-run species long before manufactured dams made the stream inaccessible about 200 years ago.

But the lowly lamprey still has an image problem, one that dates back to at least 1135 AD. That's the year King Henry I died of food poisoning after eating a bad batch, according to the history books. The first batch of lamprey was once a customary Christmas gift to the king of England, much like the first Atlantic salmon caught in the Penobscot was presented to the president of the United States, a tradition that ended in 1992.

"You're not going to restore Atlantic salmon by just stocking a whole bunch of them and not paying attention to habitat quality in the stream and other fish they coevolve with, and I think lamprey is a vital component of that functional stream."

Stephen Coghlan

Although the lamprey isn't as flashy as the sea-run superstar, the uneven, fast-moving habitat its nests create on the stream bottom could prove beneficial to the Atlantic salmon, Coghlan says, basing his research in part on hypotheses presented in a 2006 study by Rory Saunders, a biologist at NOAA's National Marine Fisheries Service.

"Atlantic salmon don't exist in a vacuum," Coghlan says. "You're not going to restore Atlantic salmon by just stocking a whole bunch of them and not paying attention to habitat quality in the stream and other fish they coevolve with, and I think lamprey is a vital component of that functional stream."

Rob Hogg, a graduate student writing his thesis on the lamprey project, noted that since the removal of the dams, the research team has documented three age classes of Atlantic salmon occupying formerly inaccessible areas of the Sedgeunkedunk.

When the sea lamprey comes back to the Sedgeunkedunk, it's in its final stage of life, and will die within a week or so. It has already spent between three and 17 years as a juvenile — a filter-feeding larva collecting food particles as it moved downstream. Then, it might have hitched a ride on a passing rainbow smelt to the ocean, where it spent the next one or two years at sea, attaching itself to other fish and, with help from its barbed "rasping tongue," sucking out their bodily fluids.

When sea lamprey return to the stream to spawn, they're tired, but not too tired to build their nests, stirring up invertebrates from the bottom and, in the process, feeding the minnows and other small fish that congregate nearby. Hogg has documented common shiners feeding on the sediment, and probably eggs and spawning lamprey introduced to the drift.

"It's pretty strong support to say these guys are providing a prey source," says Hogg, who came to UMaine three years ago from Southern Oregon University after learning of the project.

THE LAMPREY may be providing something else, too. The stream's ecosystem could also depend on its death. And, even in death, the lowly fish is proving useful to Coghlan and his research.

Down the corridor from his office in Nutting Hall is a room with a refrigerator with a note on the door apologizing for the smell. The icebox is filled with onion bags containing lamprey carcasses that have washed up in the trash racks at the Veazie Dam. Coghlan says that using a pickpole to retrieve the rotting carcasses is the worst job he's ever done.

But Coghlan has plans for these carcasses. As part of his research, they will be placed in cages in different densities in several area streams. He wants to see what effect, if any, the released nutrients — namely nitrogen and phosphorous — will have on the streams' ecosystems. The open ocean, where the lamprey spends its adult life, is energy-rich, he says. When a lamprey comes back to spawn and die, its decaying body releases that energy and fertilizes the nutrient-poor stream.

By scientific standards, Coghlan and his fellow researchers have yet to prove the lamprey's importance to the system — and ultimately Atlantic salmon habitat — but he says the potential is there.

Coghlan doesn't count himself a lamprey cheerleader — just a scientist compiling and analyzing data thanks to his many collaborators and funding agencies, including the Maine Department of Marine Resources, Maine Department of Inland Fisheries and Wildlife, Maine Sea Grant, Maine Audubon, the Atlantic Salmon Federation, the U.S. Fish and Wildlife Service, the communities of Orrington and Brewer, and his coinvestigator and frequent collaborator, Joe Zydlewski of the U.S. Geological Survey's Maine Cooperative Fish and Wildlife Research Unit.

Because he also has data from before the dam removals, Coghlan says he hopes the research on the tiny Sedgeunkedunk can serve as a model system for other dam removal projects in Maine.

Currently, he is focusing on the Penobscot River Restoration Project, which will involve the removal of two lower dams — Great Works and Veazie — and the bypassing of a third, opening more than 1,000 miles of habitat for sea-run fish in Maine. The Penobscot River, he says, is really just hundreds of Sedgeunkedunks. And the stream, although small, could provide useful data on the effects of dam removal on the Penobscot, the longest river entirely in Maine.

Coghlan cited a study that estimated that just a small fraction — perhaps as few as 5 percent — of river restoration projects nationwide are monitored after a dam removal. It's another reason Coghlan is excited about his research.

"If your goal as a manager or a citizen who elects government officials who are in charge of these restoration projects is to see a steam that functions fairly similarly to what it did back before we built dams and polluted it and overfished it, I think sea lamprey are a critical component," Coghlan says. ■

Bear bon

Photo by Darrold Dorr

Research focuses on the only mammals that don't experience bone loss despite months of inactivity

By Rich Hewitt

RITA SEGER remembers her first encounter with a black bear. She was enrolled in a University of Maine undergraduate wildlife ecology course that included a January fieldtrip led by the Maine Department of Inland Fisheries and Wildlife bear biologist, and UMaine alumnus, Randy Cross.

As she watched Cross and his team handle the bear to gather health assessment data, and affix ear tags and radio collars as part of Maine's long-term bear monitoring program, Seger began thinking about the wonders of hibernation physiology — how the American black bear manages to remain in its den for up to 6 months each year in Maine, not eating, drinking, urinating or defecating. During this time, mature females even give birth to and nurse their young.

Seger, a medical internist, found it fascinating that hibernating bears do not experience bone loss despite months of inactivity.

"I always thought I would like to study wildlife, and potentially combine medicine and wildlife studies in one way or another," says Seger, who had been practicing internal medicine for 11 years in Missouri, Alaska and Maine when she starting taking courses at UMaine to explore an additional graduate degree. "That January 2004 fieldtrip is where it all came together for me."

That fall, Seger began her Ph.D. research on bone metabolism in active and hibernating black bears. A year after seeing her first bruin, she was back in the field with Cross and his crew. Her goal was to begin to fathom the many unanswered questions as to how hibernating bears are the only mammals that do not experience bone loss due to inactivity.

"This is the most fascinating work I could hardly imagine doing," says Seger, who earned her Ph.D. in 2008 and is now, in addition to practicing medicine, a researcher in the UMaine Department of Animal and Veterinary Sciences. "Being out of doors, up close — in the dens — with these beautiful animals, that have the most complex and fascinating physiology. To me, they're captivating."

Seger and a team of researchers, which included colleagues at UMaine as well as some of the top bone researchers in the

For the bone metabolism study led by Dr. Rita Seger, blood samples and paw X-rays of tranquilized black bears were taken in the field. A comparison of 12 serum markers and X-rays in hibernating and active bears found higher amounts of the hormone leptin in hibernating bears, which correlated with serum markers of bone turnover. The research found that leptin's effect on the sympathetic nervous system may help prevent bone loss.

Photos courtesy of Rita Seger

country, may have found a clue as to what it is in the bear's physiology that wards off the effects of long-term inactivity.

In most mammals — other hibernators and humans included — months of inactivity result in significant bone loss and a host of other complications. But, in bears, there is little or no deterioration of the bone during hibernation. Learning how they do it may shed new light on bone growth and ways to prevent and perhaps treat bone loss in humans.

SEGER, WHO had an early introduction to bone science from a bone specialist advisor during medical school, recognized that bone turnover physiology would need to be modified in an animal that goes months without urinating in the setting of immobility. She hypothesized that either normal bone turnover does not take place during ursine hibernation, or there is a unique mechanism to take calcium removed from the skeleton and put it back into bone so that it does not build up in the bloodstream.

What's important to remember is that, while healthy bones appear to be hard and durable, they are, in fact, changing all the time, she says. Humans turnover on average 10 percent of their bone each year. As a very dynamic tissue, bone relies heavily on activity or "loading" to stay strong and healthy. Conversely, a lack of activity or "unloading" for extended periods of time results in significant bone loss in mammals, including humans.

For example, during 26 weeks of inactivity, a human can lose up to 40 percent of bone mass, and small hibernating mammals experience similar bone loss. If this process occurred in a hibernating bear, which does not urinate, calcium would build up in the bloodstream and wreak havoc physiologically, Seger says.

All that activity in the bones leaves traces in the blood. Seger figured that studying specific markers in bears' blood might provide a clue to how they do what they do. That's why she and her colleagues proposed taking X-rays of bear paws and tracking key indicators in blood samples. To perform those studies, she took to the field with the state bear crew led by Cross.

CROSS HAS studied the black bear population in Maine for the past 30 years as part of the Maine Black Bear Monitoring Program. The program has as many as 100 radio-collared black bears located in three study areas representing distinct habitats. Cross tracks the bears, both in their dens while they hibernate in winter, and in the spring and summer months.

"I've put my hands on a lot of bears," he says.

This past winter, for example, Cross and his team visited 75 dens and handled 185 bears; in the summer, they captured 124 bears, including some repeats, during a 34-day season in May and June. On one day alone, Cross says, they literally trapped a ton of bears using leg snares — 11 bruins with a combined weight of 2,086 pounds.

The goal of the monitoring program is to provide the Department of Inland Fisheries and Wildlife with accurate information about bear recruitment — the numbers of bears entering the population — and the numbers that die naturally in addition to those taken by hunters. The

bear study crew visits collared female bears in their dens each winter to check the number of cubs. Cubs and yearlings are tagged for identification.

Because they stay with their mothers for 16 months and den with her the following winter, the researchers can track the number of cubs that survive to age 1. Although the state biologists weigh and measure the bears, and even take hair samples with follicles for DNA testing, Cross said they do very little blood work except when working with researchers such as Seger.

"This is not a cure for osteoporosis. This is basic science and there is a lot more to be done. I do think that this contributes to understanding the way the skeleton interacts with mechanical signals and shows that the black bear may provide a useful model for this type of research."

Dr. Rita Seger

FOR HER research, Seger took blood samples from the hibernating and active bears. She took X-rays of the paws of hibernating and hunter-killed bears using a portable X-ray machine that ran on a cordless drill battery. Her husband, Rick Seger, a Bangor radiologist, measured the bears' bone mass on the X-rays.

Seger compared 12 serum markers for bone metabolism from the bears and compared their bone X-rays. The X-rays showed no significant difference in bone mass between hibernating and active bears, but the serum markers showed that bone turnover wasn't completely shut down.

One of the serum markers the researchers looked at was leptin, a hormone that works with the sympathetic nervous system to tell the skeleton that it is time to turnover bone. The blood samples showed higher levels of leptin in hibernating bears than active bears, and leptin levels correlated with serum markers of bone turnover, leading them to suspect that leptin and the sympathetic nervous system may be key to the bears' ability to maintain bone strength.

"The skeleton in hibernating bears seems to turn off cues that tell the skeleton it is unloaded, so it believes it is under normal loading all winter and does not break down," Seger says.

To investigate this possibility further, the researchers measured sclerostin, a protein that normally increases during unloading, hypothesizing that hibernating bears might maintain normal levels of sclerostin to trick the skeleton into believing that it was normally loaded during hibernation. But the data did not support that hypothesis because the sclerostin levels in the hibernating bears were elevated, indicating that the bones recognized that they were unloaded.

"This is not a cure for osteoporosis," says Seger, who is now developing her next round of bear bone research. "This is basic science and there is a lot more to be done. I do think this contributes to understanding the way the skeleton interacts with mechanical signals and shows that the black bear may provide a useful model for this type of research." ■

Cold-water corals, top to bottom: *Iridogorgia megaspiralis, Paragorgia arborea* and *Desmophyllum dianthus.* Photos by Rhian Waller, DASSO5_IFE_URI_NOAAOE

Cold coral

Research sheds light on the little-known marine animals living at the darkest depths of the oceans

By Jessica Bloch

SCIENTISTS HAVE long known that corals are found far beyond shallow, tropical waters. Since the 1800s, researchers on multiyear voyages have collected coral samples from colonies found at much deeper, darker, colder spots in the ocean.

In the past two decades, coral also has surfaced on trawlers working in more remote fishing grounds in the hunt for an increasingly elusive catch. And that's when the importance of these invertebrate animals became apparent, and when Rhian Waller began her Ph.D. research on the reproduction and development of the seldom-seen creatures.

Waller's research now focuses on how factors such as climate change, fishing and oil exploration affect deep-sea coral reproduction, and what effect that altered life cycle could have on the rest of the marine ecosystem.

"We're now beginning to realize that these reefs in the deep sea are very similar to the reefs in shallow water and can be very important to certain fisheries species," says Waller, a University of Maine assistant research professor in the School of Marine Sciences. "These corals have thousands of associated species that live on and around them, so we're starting to realize they're important deep-sea ecosystems builders, just like corals in shallow waters."

"Our understanding of deep-sea biology is still very much in its infancy, so there's a lot we don't know. But we do know from other areas that you can upset the whole ecosystem by taking just the one bottom piece away." Rhian Waller

Earlier this year, Waller received a more than $78,000 RAPID Grant from the National Science Foundation and a $30,000 National Geographic Society award to establish three long-term monitoring sites in Chile, where she will sample corals for reproductive ecology studies. Waller also received another $9,000 from UMaine to explore Maine's coastal areas for deepwater emergent coral habitat sites, and $48,000 from the National Oceanic and Atmospheric Administration (NOAA) to continue a long-time series in Alaska of red tree corals.

Through each project, Waller hopes to show the importance of deep-sea coral systems to the ocean ecosystem.

"If we continue to damage these coral habitats, we're going to damage the fish and invertebrate populations that live around them," Waller says. "Even though they're out-of-sight, out-of-mind, and many people don't know they're there, we have to start to explore and research why these ecosystems are important."

WALLER GREW UP in England and Riyadh, Saudi Arabia, where she spent weekends snorkeling off coral reefs in the Red Sea or the Arabian Gulf while her parents scuba dived. That experience sparked her fascination with the beautiful, mysterious animals.

Corals are marine invertebrates, in the same phylum as jellyfish and anemones, but corals can form a calcium carbonate skeleton. Corals are made up of individual polyps — some just single polyps with skeletons; others, such as larger reef-building corals and gorgonian sea fans, can be many thousands of genetically identical polyps all living joined together.

There are two types of corals. Tropical

Cold coral

Rhian Waller, an assistant research professor in the UMaine School of Marine Sciences, is studying deep-sea corals living in the coldest, darkest depths off Alaska, Chile and Maine.
Photo courtesy of Rhian Waller

corals have photosynthetic algae known as zooxanthellae, which require sunlight and warm water to survive, and are found at less than 100 meters depth.

Waller studies the other kind of corals, which do not have zooxanthellae and so do not require photosynthesis. Instead, they survive solely on food in the water column. Although they can live in the relatively shallow, cold waters of Alaska, northern Canada, southern Chile and the Antarctic — areas where corals that have zooxanthellae can't survive because of the temperatures — these corals are most often found in the deep sea — usually more than 500 meters deep, roughly the end of a continental shelf, and below the depths scuba divers can go.

Such deep-sea corals have been found to be thousands of years old. The current record holder is a 4,000-year-old coral found off the coast of Hawaii.

The depths at which deep-sea corals grow is also one of the reasons so little is known about them. Researchers in the small community of deep-sea coral science typically retrieve and preserve specimens for each other, and fishermen and conservation agencies occasionally hand over samples they find. Most corals are retrieved via manned submersibles, remotely operated underwater robots or human dives, if the depth is shallow enough.

In southern Chile and southern Alaska, for example, which both have glacial fjord ecosystems that are too cold for photosynthesis and little competition for space, some corals typically found at deep-sea depths are living much shallower.

In Alaska, Waller is working on a species known as the red tree coral typically found at 500 meters, but recently discovered at less than 10 meters, which means she can scuba dive for samples year-round, rather than using a submersible.

Scientists haven't yet discovered why the deep-sea corals are being found at shallow depths, but they believe it is because the water is colder and darker than tropical waters, and competition from photosynthesizing species (such as fast-growing algae) is less, making the environment more like the deep-sea than a regular shallow-water ecosystem.

The deepest dive for corals Waller has made in a submersible was to 3,600 meters on the New England seamount chain in 2005.

WITH MORE research on deep-sea corals, scientists are discovering just how much their presence affects the world around them. One example, Waller says, is deep-sea corals have been found harboring eggs of the Dumbo octopus, a small creature that lives in deep waters about which little is known. As yet, deep-sea corals are the only place those eggs have ever been found.

Scientists wonder what else might live or rely on the corals, and how the food chain would be affected if the corals began to disappear.

"You can imagine all it takes is one trawler or one piece of garbage to land on the coral and suffocate it, and that's 4,000 years of growth and 4,000 years before that colony will grow back to support 1,000 different invertebrates which, in turn, support maybe tens of different

species of fish," Waller says. "Our understanding of deep-sea biology is still very much in its infancy, so there's a lot we don't know. But we do know from other areas that you can upset the whole ecosystem by taking just the one bottom piece away."

WHEN WALLER began her Ph.D. research at Southampton Oceanography Centre in England, there were no published studies on reproduction in deep-sea corals, even though there are more than 3,000 species living at deep spots in the ocean, compared to around 2,000 species of shallow-water corals.

Waller set out to establish some basics about deep-sea coral reproduction, such as whether the corals are males, females or hermaphrodites; if they reproduce via broadcast, as the shallow-water corals do; if they brood larvae; and have multiple offspring. Also, what time of year they reproduce.

She has also looked at larval processes and managed to get different corals to spawn in order to closely examine their larvae.

Waller's research compares deep-sea pristine regions to those that faced fisheries damage and found that corals that were constantly being turned over and broken reproduced in much lower numbers or not at all. Answering questions about how and why this happens at different depths in the ocean is at the crux of Waller's research.

"If there is any kind of stress, reproduction can cease," she says. "Looking at how these stressors are affecting reproduction, whether populations are sustainable, how reproduction changes in the same species that are living at different depths and how all those things are being changed, both by human activity and the general environment, is really where my interest lies."

Waller's work in Alaska involves reproduction processes of red tree coral in the Alaskan fjords, where the animals form essential habitat for rockfish and crustacean species. In 2010, Waller and NOAA collaborators established a site of 40 corals, which have since been sampled every three months for reproductive analysis. This site has provided the best time-series reproductive data on any deep-water coral species to date.

Waller will return this January to investigate fertilization and larval dynamics in the species, and continue the reproductive timeline to assess when and how much it reproduces, with the goal of providing management information.

RESEARCHERS are starting to realize that climate change may affect deep-sea corals more than previously believed — perhaps more than it does shallow tropical corals. Although there is no doubt that tropical corals are heat-stressed, Waller says, they can live within temperature swings of up to 15 degrees. But for corals in the deep sea, where the water is much colder, has stable temperatures year-round and is relatively acidic compared to surface waters, a temperature swing of up to 2 degrees in a year could make for a complete change.

Waller has seen deep-sea corals brought up from the Antarctic region that, due to deterioration in the ocean, disintegrate when handled.

A selection of deep-sea corals from the Drake Passage, Antarctica, clockwise from top right: *Armadillogorgia sp.;* brittle star atop a *Solenosmilia variabilis,* Stylasterid coral habitat; *Armadillogorgia sp.; Flabellum curvatum;* rocky coral community; *Bayergorgia vermidoma; Desmophyllum dianthus; Errinopsis sp.; Balanophyllia malouensis.*

Photos by Dann Blackwood, Rhian Waller and the NBP11-03 Science Crew

Cold coral

Gorgonian corals, like this red tree coral specimen from southern Alaska, will be characterized and mapped in the Gulf of Maine as part of Rhian Waller's research. Photo courtesy of Rhian Waller

Corals in Chile's northern Patagonian fjords are facing pressures from intense salmon farming and logging, which is why there is an urgent need to document and understand the coral systems in this region. Measurements of reproduction will add to understanding of recruitment, recolonization, population connectivity and recovery from damage in this area.

In Chile, Waller launched her research from the Huinay Scientific Field Station. She works in the northern Patagonian fjords, which are influenced by strong tides, large volumes of freshwater runoff, upwelling of deep ocean waters and steep climatic gradients from north to south. Species in these fjords can more usually be found at depths of up to 3,000 meters, yet in these locations they can now be collected at just 10 meters. This presents a unique opportunity to form baseline data on ecological and population processes — a window into a deep-sea ecosystem.

WALLER'S GOALS in Maine are to discover, characterize and map areas of gorgonian corals, also known as sea fans or sea whips. She intends to register the new locations and depth ranges in the U.S. Geological Survey Cold Water Coral Geographic Database.

She also hopes to discover a scuba-accessible site from which to launch studies of deep-sea, cold-water coral ecology and physiology — ideally, within an easy boat ride from UMaine's Darling Marine Center in Walpole, Maine, where she is based. To that end, she has been working with Chris Rigaud, the Darling Center's diving safety officer, to train for deeper dives in gulf waters.

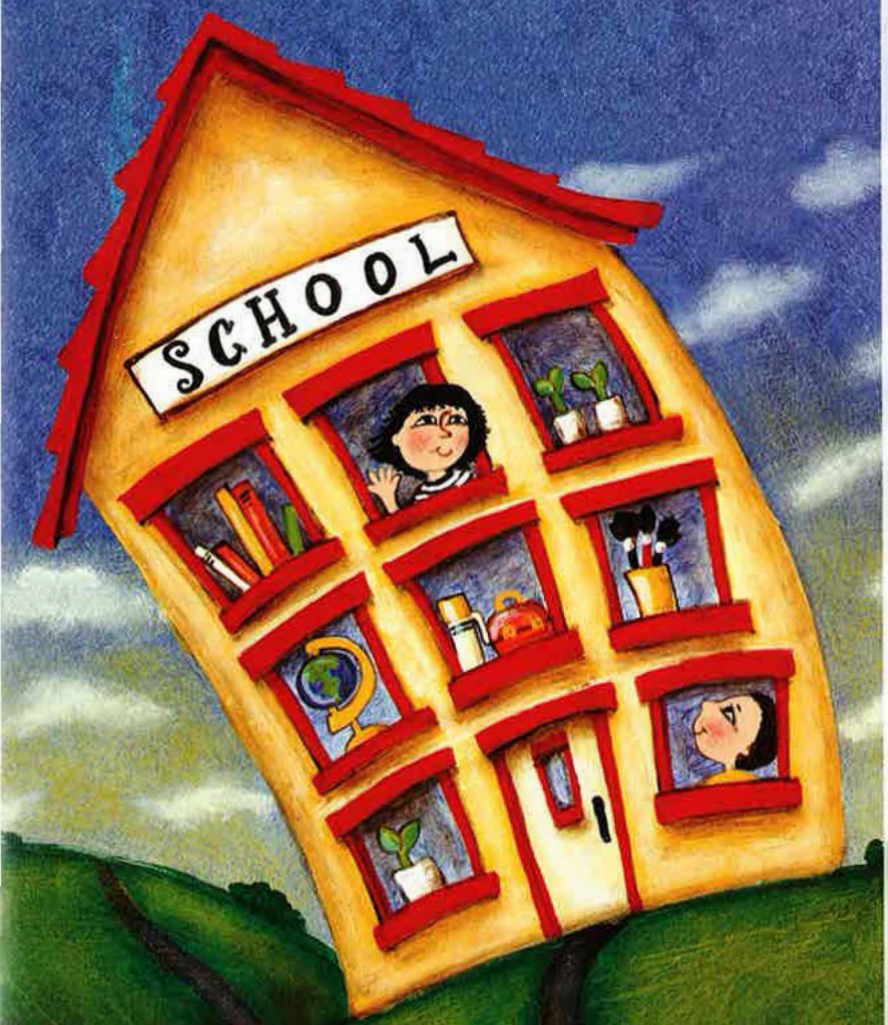
Although Waller has seen photographic evidence of red tree corals pulled from the area around Monhegan Island, there have been only sporadic reports in the last 100 years of deep-sea corals coming up in shallower gulf waters.

"Just as in Alaska, we have areas where it is cold all year round, and we have deep-water coming up on the shelf," Waller says. "But the oceanographic conditions here are very different from Alaska, so although we might get species that usually live within 1,000 meters or so, they're probably not going to come up within meters of the surface, like we have seen in other high-latitude areas. We might be able to find them within 50 to 100 meters, which is within technical diving limits."

More than 60 species of cold-water coral are known in the Gulf of Maine, but little is understood of their biogeography and diversity. However, anecdotal and other information gathered from fishermen indicate the distribution of coral communities may be wider than thought, particularly closer to shore.

The same concerns about environmental impacts on deep-sea coral apply in the Gulf of Maine, with one exception. While there are no offshore oil exploration platforms in the gulf, there could soon be deep water offshore wind turbines anchored to the ocean floor there. Anchoring devices could be a boon for deep-sea corals, Waller says, in the same way that disused oil rigs in northern Scotland and the Gulf of Mexico provide habitat for corals.

"I would predict a similar situation with offshore wind platforms, although they're not going to be placed in rocky areas where we tend to find deep-sea corals," she says. "There is the potential they could form great hard substrate habitat, allowing coral larvae to grow and maybe thrive." ■



Courage to Teach

An initiative to renew the passion, commitment and integrity of educators

AT A TIME of school budget cuts, district consolidations, and new federal and state policies measuring student and teacher performance, public education is under intense pressure. Then there are complex, challenging student life issues, burdensome school policies and regulations, and competitive peer environments.

In such a climate, many new K–16 educators leave the profession in their first three to five years, and many mid-career teachers are stressed, disheartened and overwhelmed.

The Courage To Teach® (CTT) initiative is sponsored in Maine by University of Maine Cooperative Extension and led by UMaine Extension Educator Doug Babkirk, in partnership with Richard Ackerman of the College of Education and Human Development. The program seeks to strengthen and renew the inner resources and lives of educators, and give them the courage they need to align who they are with what they do.

CTT is a national effort of the Center for Courage & Renewal to support K–16 teachers in bringing their full identity and integrity to teaching; renewing their vocational commitment and aspirations; building circles of peer support; and generating collegial leadership to strengthen schools and higher education institutions as respectful, effective and vibrant learning communities.

In Maine, five CTT facilitators offer personal and professional renewal programs for public school and higher education administrators and teachers. In the past four years, the facilitators have worked with 250 Maine educators. ■

Timekeepers

Ancient clamshells provide clues to the Atlantic Ocean's past

By Jessica Bloch

Because shifts in temperature and salinity can change the chemistry of calcium carbonate shells, scientists in UMaine's Climate Change Institute can use them to understand changes in the Gulf of Maine in the last 1,000 years.

FOR SCHOOLCHILDREN, dendrochronology is a common lesson. Simply put, by counting the growth rings of a tree, you can tell how old it is. But trees aren't the only living things with growth rings, and age is just a small bit of information that those rings can communicate.

University of Maine researchers Karl Kreutz and Douglas Introne are reading the rings of clamshells — a practice known as sclerochronology — as a crucial tool in understanding how the characteristics of the Gulf of Maine have changed in the last 1,000 years. Those changes provide links to a broader picture of how the climate has changed in the same time frame.

"When something happens in the North Atlantic, it's transmitted to Maine," says Kreutz, a professor in UMaine's School of Earth and Climate Sciences, and the director of the university's Stable Isotope Lab, where the shells are analyzed. The lab is a UMaine Climate Change Institute facility specializing in the measurement and interpretation of the light-stable isotopic ratio of environmentally relevant elements, such as hydrogen, carbon, nitrogen, oxygen and sulfur.

"If we can use these shells to see what has happened in the Gulf of Maine, we

can interpret what's happened in the Atlantic. And that's really the big prize, to try to figure out if and how the North Atlantic oceanography has changed over the past 1,000 years.

"The behavior of the North Atlantic, we now know after many people looking at this over the past 20 years, has a big role to play in global climate. The Gulf Stream current and the way it changes certainly influences the entire North Atlantic region, but has more global implications as well."

Kreutz, Introne and colleagues at Iowa State University have been collecting clamshells from the Gulf of Maine to build a detailed chronology of how the water temperature in the gulf has changed, which they can see in chemical analyses of the clamshells. Although the researchers have been able to document some results for centuries' worth of information, a National Science Foundation (NSF) grant of $500,000 has allowed them in the last two years to continue to collect clamshells and fill in hundreds of years more of data that were missing.

"So far it looks to us as though the Gulf of Maine has actually been cooling over the past 1,000 years and was at least cooler today than 1,000 years ago," Kreutz says. "That generally lines up with what we think was happening in the North Atlantic with the Gulf Stream. But we have huge gaps in the middle, and the results we're getting now will fill in those gaps. As long as you have the data, you can stitch it together and can tell what's going on year to year, or summer to summer, or summer to winter, for a detailed record."

"If we can use these shells to see what has happened in the Gulf of Maine, we can interpret what's happened in the Atlantic. That's the big prize — to try to figure out if and how the North Atlantic oceanography has changed over the past 1,000 years." Karl Kreutz

THE RESEARCH and NSF funding are a continuation of work that started nearly 20 years ago when Introne, now the assistant director of the Stable Isotope Lab, and Climate Change Institute founder and Professor Emeritus Harold Borns began looking at clamshells.

The research took a major step forward about eight years ago when then Ph.D. student Alan Wanamaker, working at UMaine's Darling Marine Center in Walpole, Maine, set up a system of tanks in which he grew a blue mussel *(Mytilus edulis)* commonly found on coastal Maine beaches. The chemistry of the calcium carbonate mussel shell changes with such factors as temperature and salinity.

"We grew bivalves under controlled but differing temperature and salinity conditions," says Wanamaker, now an assistant professor who directs the Stable Isotope Lab at Iowa State, where he works with 2009 UMaine graduate Shelly Griffin, who is pursuing a Ph.D. on the Gulf of Maine work with Wanamaker.

"We then related the chemistry and temperature of the water to the newly grown shell material," he says. "From these experiments, we developed a method, the so-called transfer function to hindcast seawater temperatures using the oxygen isotopic composition of these particular bivalve species. From this work, we have gone on to use this technique on other bivalve species and other biocarbonates to estimate the natural variability in marine systems."

Wanamaker's mussel shells were analyzed in UMaine's Stable Isotope Lab. The goal was to determine the relationship between the temperature and chemistry of the water, and the chemistry of the shell itself.

Timekeepers

To determine how the growth of the shells has been affected by water temperature and chemistry, researchers take shell material from the rings. Through the chemical analysis, the stable isotope patterns in each ring can indicate if the water temperature was particularly warm or cold in a given year. Taking into account those results, the researchers could tell if a mussel grew a lot during, say, a period of several years in which the water temperature was particularly warm, or didn't grow much at all during a period in which the water was colder.

The stable isotope results of Wanamaker's original work provided a baseline that all three researchers are now applying to the new project.

To determine how the growth of the shells has been affected by water temperature and chemistry, researchers take material from the rings using a micromill. Through chemical analysis, the stable isotope patterns in each ring can indicate if the water temperature was particularly warm or cold in a given year.

THE RESEARCHERS have been collecting the shells of *Arctica islandica,* a Gulf of Maine quahog clam often found in commercial clam chowder, which has a life expectancy of around 150 years. For the past three summers, the researchers hired a lobster boat with a scallop dredge to collect shells in Gulf of Maine sites, such as Isle au Haut, Isles of Shoals and Seguin Island near Popham Beach.

The dredge pulls up not only live clams but also subfossil shells, which are dated using radiocarbon techniques to determine when they were alive. Once a shell's age is known, researchers look at the individual rings in the shell, paying particular attention to patterns.

"You look for the same pattern in another shell and match it up, and just build them up with time," Kreutz says.

The researchers have been able to compare results from the clamshells to actual water temperature readings from the Gulf of Maine, but the water temperature records only go back 80 years. So far, the isotopes match the records.

Those results and other related research activities will have another life as an iPad educational application intended for students in kindergarten through fifth grade. The app will introduce youngsters to general climate concepts, with an interactive timeline that will show major climatic and other significant events of the last 1,000 years.

Videos and photos will show details of the clamshells so that users can see the growth rings, and an introduction of the science behind their use.

Kreutz has been developing the app with Josh Plourde, a UMaine undergraduate student majoring in Earth science.

"We envisioned the app mostly from an educational standpoint," Kreutz says. "We wanted to have something that brings all these ideas to the table in a way that teachers could use them." ■

UMaine researchers are collecting the shells of *Arctica islandica,* a Gulf of Maine quahog clam, which has a life expectancy of around 150 years.

The buzz in Murray Hall

Honeybee colony offers important biological lessons

Six-year-old Tanner Smith is among the many fans of the Murray Hall honeybee colony. (Tanner stopped by after school, where he had just had class photos taken. Thus, the bow tie.)

IN SEPTEMBER, 20,000 honeybees took up residence in the foyer of Murray Hall as part of a live exhibition in the School of Biology and Ecology.

"Biology is all about life," says school director Eleanor Groden. "The bees are a representation of life that links people, food and health with the environment and the natural world. We wanted something that would really draw people in."

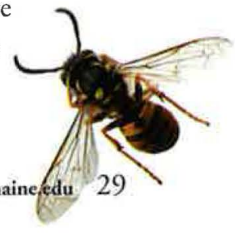
Since the installation of the 2-foot by 5-foot sealed frames that pivot from the wall, the buzz hasn't stopped in Murray. The exhibit has become a popular destination for visiting school groups. UMaine faculty and staff typically making beelines to their destinations now regularly pause to check on the hive, and students going to and from nearby classrooms, labs and lecture halls often swarm the glass panels to glimpse the goings-on.

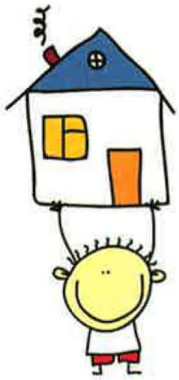
There's even a "beecam" installed near an opening in the wall that gives the bees access to the great outdoors. Fans can watch online as the bees move in and out of the hive, even in the winter.

And the queen of the hive? There was a naming contest that drew 78 entries. She has been dubbed Phoe-bee.

The colony will not be managed for honey production. Its value is in the daily glimpses it provides of life in a bee colony and the constant reminder of the importance of such insects to humans. Honeybees are responsible for pollinating approximately 80 percent of all fruit, vegetable and seed crops in the United States.

University of Maine entomologists have been conducting honeybee research for nearly two decades, maintaining up to four apiaries with upward of 60 colonies in any given year. Most recently, the research has focused on the effects of commonly used pesticides on honeybees, and the relationship between honeybees and native bees in pollinating Maine's wild blueberry crop. Since 2009, UMaine also has been part of a seven-state study on the causes of colony collapse disorder that has brought a rapid decline of bees worldwide. ■





Caring for the youngest victims of substance abuse

IN PENOBSCOT and Piscataquis counties, children ages 5 and under whose families are struggling with substance abuse will have improved well-being and safety, and a better chance of staying in or returning to their own homes rather than remaining in foster care under a five-year, $3.9 million project led by the Bangor-based Families And Children Together (F.A.C.T.), the University of Maine School of Social Work, and a coalition of community organizations and agencies.

Penquis Regional Linking Project: Building Quality Services for Rural and Frontier Communities will receive $797,405 annually for five years from the Promoting Safe and Stable Families program of the Administration for Children and Families, Children's Bureau. It will involve at least 25 area service agencies, led by F.A.C.T. and Beverly Daniels, the executive director of F.A.C.T. Jennifer Middleton, a UMaine assistant professor of social work, is the lead researcher on the project and co-director of evaluation with Len Kaye of the UMaine Center on Aging.

The Penquis Regional Linking Project is a "community engaged" research project and one of the first of its kind in the nation to implement and evaluate a trauma-informed system of care for substance-exposed infants and their families.

Regional warming confirmed during Holocene

ACROSS THE GLOBE in the past century, mountain glaciers have been melting in response to warmer atmospheric temperatures. They include peaks in the European and Southern Alps — formations found on opposite sides of the globe.

New research led by scientists at the University of Maine's Climate Change Institute has documented that unlike the concurrent, widespread melting occurring today, glaciers in European and Southern Alps 11,500 years ago experienced regional climate and oceanographic variability.

The findings of the international research team, led by then UMaine Ph.D. student in Earth sciences Aaron Putnam, provide evidence that changes in glacier behavior in the preindustrial age were not caused by global atmospheric warming. As reported in *Nature Geoscience,* the researchers suggest that today's glacier recession in New Zealand and Europe is unlike what occurred in those mountain ranges in the preindustrial Holocene period, and corresponds with human-produced greenhouse gases.

Putnam and his team worked on Cameron Glacier in the central Southern Alps. They reconstructed glacier fluctuations and associated temperature variations for the past 11,000 years using moraine geomorphology and high-precision beryllium-10 (10Be) surface exposure dating — a measure of the cosmogenic nuclide on rock faces to determine the age of landforms marking what were once the edges of glaciers.

They found that, in the 10,000 years that preceded industrial time, Cameron and other glaciers of the Southern Alps retreated while those in Europe advanced. In contrast, glaciers in both places have receded over the past century.

Putnam, a native of Chapman, Maine, is now a postdoc at Columbia University.

"This project has the potential to strengthen the system of care for families affected by substance abuse, helping parents and caregivers access important resources, and reducing the isolation and stigma often experienced by these families."

Jennifer Middleton

Countering muscular dystrophy symptoms

BOOSTING THE ACTIVITY of a vitamin-sensitive cell adhesion pathway has the potential to counteract the muscle degeneration and reduced mobility caused by muscular dystrophies, according to a research team led by scientists at the University of Maine.

The discovery, published in the open access journal *PLOS Biology,* is particularly important for congenital muscular dystrophies, which are progressive, debilitating and often lethal diseases that currently remain without cure. The researchers found that they could improve muscle structure and function in a zebrafish version of muscular dystrophy by supplying a common cellular chemical (or its precursor, vitamin B3) to activate a cell adhesion pathway.

Muscle cells are relatively delicate, but derive important additional mechanical strength from adhesion protein complexes; these anchor the muscle cells to an external framework known as the basement membrane, thereby helping to buffer the cells against the extreme forces that they experience during muscle contractions. Mutations in the genes that encode these adhesion proteins can weaken these attachments, making muscle cells more susceptible to damage and death.

The resulting muscle degeneration can eventually lead to progressive muscle-wasting diseases. A major component of the basement membrane, a protein called laminin, binds to multiple different receptors on the muscle cell surface and forms a dense, organized network.

The study was led by UMaine Associate Professor of Biological Sciences Clarissa Henry. The researchers discovered that a pathway involving a common cellular chemical called nicotinamide adenine dinucleotide (NAD+) plays a role in the formation of organized basement membranes in muscle tissue, during development of the fish embryo. As disordered basement membranes are seen in many different types of muscular dystrophies, the researchers wondered whether activating this pathway might reduce the severity of some muscular dystrophies.

Bd

UMaine mycologist Joyce Longcore was the first to isolate a pure culture of the chytrid in 1997 in response to a die-off of exotic frogs in captivity at the Smithsonian National Zoological Park in Washington, D.C. Simultaneously, scientists found the organism decimating frog populations in Australia and Central America. Not only are Longcore's cultures key to understanding origins and implications of Bd, but her methods for culturing the problematic pathogen bring international researchers to her door.

Culture of a killer

IN THE NOVEMBER issue of the journal *Molecular Ecology,* a U.S. and Brazilian research team reported evidence of novel and hybrid strains of a lethal fungus that has decimated amphibian populations worldwide. The paper reported on the genetic diversity of the fungus on introduced, native and cultivated North American bullfrogs that supply the global market for frog legs.

The genetic work was possible with the help of one of the most comprehensive collections of frog fungus cultures in the world, located in the Maine Chytrid Laboratory led by mycologist Joyce Longcore, a research associate professor in the University of Maine's School of Biology and Ecology.

For more than a quarter century, Longcore has isolated and cultivated aquatic fungi known as chytrids. Her cultures are a resource for studying the relationships of these microscopic fungi and have been used in recent descriptions of several new taxonomic orders. Her cultures of the fungus that causes chytridiomycosis in amphibians, known as *Batrachochytrium dendrobatidis* (Bd), reflect samples from all over the world and are used in labs in the U.S., Central America and Europe to study pathogenicity, host resistance and distribution of the fungus. In this specialized field of amphibian disease research, the Maine Chytrid Laboratory is to frog fungi what The Jackson Laboratory is to mouse strains.

Whales and ship noise

BALEEN WHALES may be more capable of detecting oncoming ships when swimming in deeper water rather than at the sea surface because of lower sound levels and acoustic "shadow zones" at the bow, according to a new study led by University of Maine Ph.D. candidate Kaitlyn Allen.

The findings, published in the journal of the Acoustical Society of America, may help explain why some whales at the surface have appeared to not detect nearby ships and turned into their paths.

The researchers found that ship noise radiated asymmetrically and varied with depth. In particular, looking at bow null-effect acoustic shadow zones, cruise ships had the greatest variation in broadband source level and fishing vessels the lowest. The findings suggest that hull construction and/or type of propulsion may play more of a role in whale-ship strikes than the increased speed of the vessel when baleen whales are traveling near the surface.

Cruise ships had the greatest variation in noise levels

From June to September 2009, the researchers used a vertical hydrophone to record radiated noise from 24 high-speed watercrafts, cruise ships, catamarans and fishing vessels in the Bar Harbor shipping channel, which also is a feeding ground for finback, humpback and endangered North Atlantic right whales.

The cost of childhood obesity

THE MEDICAL COSTS of obesity for the current cohort of children and adolescents in Maine could reach an estimated $1.2 billion over the next 20 years, according to a new study by a University of Maine economist.

UMaine professor of economics Todd Gabe's study suggests that the incidence of obesity is likely to increase from 7.8 percent of Maine's kids and teens to an estimated 25.7 percent as they grow into adults.

In his study, Gabe used statistics from the U.S. Centers for Disease Control and Prevention, and data on upward of 2,000 school-age children in Maine, compiled by physical education teachers in 18 schools across the state. The data on schoolchildren was collected during the last three years as part of ongoing research in the UMaine College of Education and Human Development, led by physical education professors Steve Butterfield and Robert Lehnhard, with statistician Craig Mason, kinesiology and physical education master's graduate Sarah Livingstone, and exercise science graduate student Aaron Runner.

The physical education research team began collecting fitness data on Maine schoolchildren after training physical education teachers in the use of a standardized periodic fitness test called PACER (Progressive Aerobic Cardiovascular Endurance Run), designed by the Cooper Institute.

The physical education project, funded in part by the Betterment Fund in Maine, is one of the first of its kind in the nation, Butterfield says, and could become a national model for quantifying the extent and cost of obesity.

Ancient urban life

NEW RESEARCH SHOWS that the ancient city of La Milpa in Belize may have built up more gradually and declined slower than previously understood, leading researchers, including University of Maine anthropologist Gregory Zaro, to believe this city persisted generations longer than first thought. Zaro and co-author Brett Houk of Texas Tech University, who published their findings in the journal *Ancient Mesoamerica*, found evidence that La Milpa persisted into the 10th century. Their revised chronology, anchored largely to new radiocarbon dates and the presence of ceramics known to have been produced very late in Classic Maya civilization, has implications for previous models of ancient Maya population growth, decline and, ultimately, the collapse of Classic Maya civilization in the eastern Petén region of Guatemala and Belize. The investigation of ancient urban landscapes in the Maya region and elsewhere generates comparative information for contemporary urban life around the world, Zaro says.

AT THE 2012 Mitchell Lecture on Sustainability held on the University of Maine campus in September, I had the honor of introducing Sen. George Mitchell, as well as hosting Professor Pamela Matson of Stanford University, who encouraged our transition to sustainability. At UMaine's Mitchell Center and as part of Maine's Sustainability Solutions Initiative, researchers are imagining a brighter economic, social and environmental future for the people of Maine through sustainability.

George Bernard Shaw was known to comment, "You see things; and you say, 'Why?' But I dream things that never were; and I say, 'Why not?'" At the University of Maine, our faculty and student scholars ask why not. They imagine.

Under the new Blue Sky Project, we are envisioning UMaine becoming the most distinctively student-centered and community-engaged of the American research universities, and we're taking five strategic pathways toward implementation. We're imagining ways to serve Maine by catalyzing revitalization; to secure UMaine's financial sustainability; to embrace a culture of excellence by promoting community and collaboration; to transform lives by strengthening the undergraduate and graduate student experience; and to renew our pride and stewardship of place.

Daring to imagine — to think differently — is nothing new to our researchers, who are among the best in their fields. Indeed, at UMaine there has long been a theme: Imagine knowing first. In this issue of *UMaine Today* are wonderful examples of scholars who dare to imagine and, as a result, make contributions that shape our world.

Imagine developing the spatial informatics that could one day lead to development of technology to help people with visual impairments lead more independent lives. Ask why black bears are the only mammals that do not experience bone loss due to long-term inactivity and conduct research to find the answer.

Imagine a marine world without deep-sea coral or a freshwater stream without sea lamprey, and conduct research to understand the roles those animals have in the ecosystem — and what would happen without them.

And what if, by asking basic biological questions, a UMaine research team discovered a new vitamin-based treatment with the potential to counter the symptoms of muscular dystrophy.

Just imagine.

Paul W. Ferguson
President

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Photo by photodrake.com

Making education more accessible

"My late husband Sonny was a quiet philanthropist who believed strongly that education was the key. He dedicated his life to helping others succeed."

Joanne Banks Miller

Sanford "Sonny" Miller and Joanne Banks Miller, a member of the University of Maine Class of '59, established the Sanford and Joanne Miller Onward Program Scholarship at the University of Maine Foundation in 2005 to support students in need, especially those seeking a new start for themselves. The Onward Program began in 1970 as a way to make the University of Maine more accessible to students who, for academic and economic reasons, might not otherwise attend college.

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